April 2, 2025 MIR-25-13

Diesel Generator Engine Failure aboard Passenger Vessel *Ocean Navigator*

On October 18, 2023, about 0710, the passenger vessel *Ocean Navigator* was moored at the Ocean Gateway Terminal in Portland, Maine, with 210 persons aboard when the no. 2 auxiliary diesel generator engine suffered a mechanical failure (see figure 1 and figure 2).[1] The failure led to the ejection of components from the engine and resulted in a fire in the engine room. Crewmembers secured ventilation to the engine room, and the fire self-extinguished. One crewmember near the engine at the time of the failure was seriously injured. No passengers were injured, and no pollution was reported. Damage to the vessel was estimated at $2.4 million.[2]

Figure 1. *Ocean Navigator* docked in Portland, Maine, on October 19, 2023, after the fire.

[1] In this report, all times are eastern daylight time.

[2] Visit ntsb.gov to find additional information in the public docket for this NTSB investigation (case no. DCA24FM004). Use the CAROL Query to search investigations.

Casualty Summary	
Casualty type	Machinery Damage
Location	Ocean Gateway Terminal, Pier 2B, Portland, Maine 43°39.37' N, 70°14.93' W
Date	October 18, 2023
Time	0710 eastern daylight time (coordinated universal time –4 hrs)
Persons on board	210
Injuries	1 serious
Property damage	$2.4 million est.
Environmental damage	None
Weather	Visibility 10 mi, overcast, calm winds, air temperature 49°F, morning twilight 0630, sunrise 0659
Waterway information	Harbor; depth 33 ft

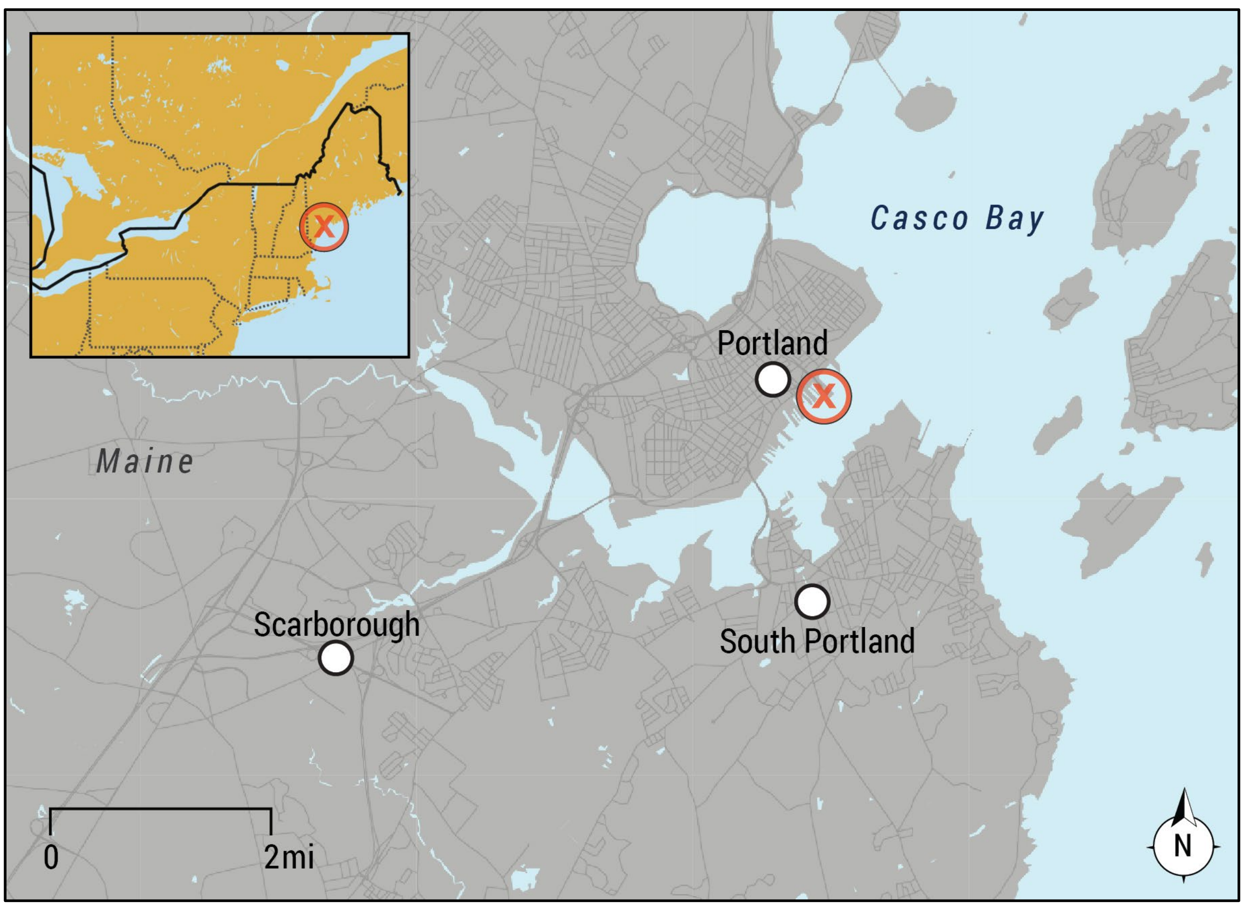

Figure 2. Area where the *Ocean Navigator*'s auxiliary diesel engine failed and a fire broke out, as indicated by a circled X. (Background source: Google Maps)

1 Factual Information

1.1 Background

The 300-foot-long *Ocean Navigator*, a passenger vessel constructed of welded steel, was built in 2004 at Atlantic Marine Shipyard in Jacksonville, Florida. The vessel was originally built as the *Cape Cod Light* and had also been previously named *Sea Discoverer and MS Victory II*. In 2017, Victory Cruise Lines acquired the vessel, and in November 2018, American Queen Voyages (AQV), a subsidiary of Hornblower Cruises and Events, LLC, purchased Victory Cruise Lines. In 2020, the vessel was taken out of service for 2 years due to the COVID-19 pandemic. In 2022, it was renamed *Ocean Navigator* and returned to service, taking passengers on multi-day coastal cruises of Canada and the United States. The vessel's 6-month sailing season began in April 2023 and was scheduled to run through October 27.

The vessel's propulsion was provided by two main engines (nos. 1 and 2 main engines), each driving a 2,682-hp azimuthing stern thruster. Vessel electrical power was supplied by two diesel-driven electrical generators (nos. 1 and 2 auxiliary engines). All four engines were Caterpillar 3516B diesel engines, each rated at 2,000 hp (see figure 3). The main engines operated at variable revolutions per minute based on the vessel's input speed command. The auxiliary engines ran at 1,800 rpm. A 1,000-horsepower bow thruster, and the two stern thrusters, each driven by an electric motor, assisted maneuvering.

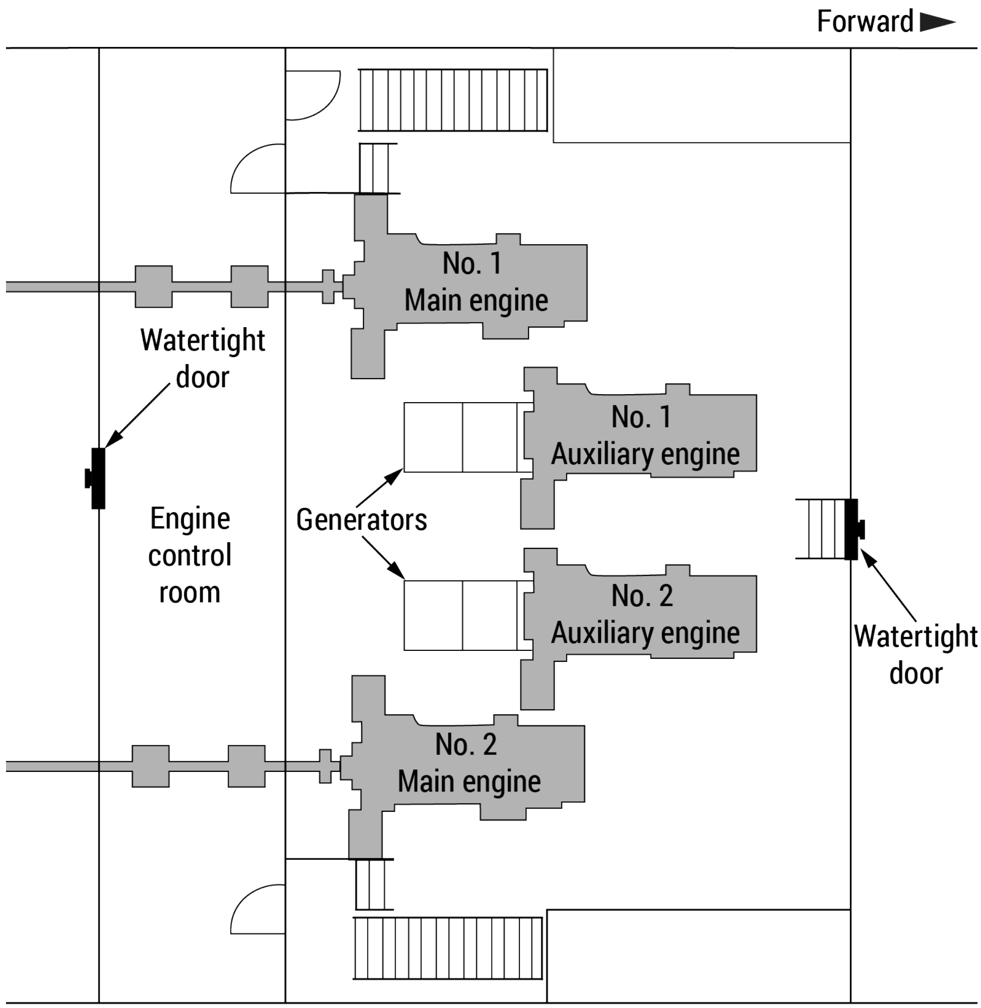

Figure 3. *Ocean Navigator* engine room layout with location of main and auxiliary engines.

The *Ocean Navigator* was outfitted with 110 staterooms with a maximum capacity of 220 passengers. The vessel had five passenger decks, decks 1 through 5, four of which contained cabins (see figure 4).

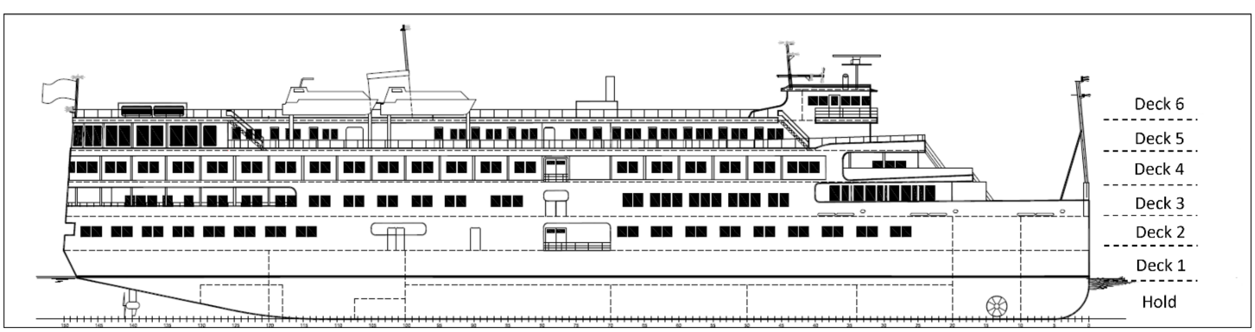

Figure 4. *Ocean Navigator* profile view. (Background source: Victory Cruise Lines [formerly AQV])

1.2 Event Sequence

On October 9, 2023, the *Ocean Navigator* began a 10-night cruise from Montreal, Canada, to Boston, Massachusetts, with 128 passengers and 82 crewmembers aboard. Between October 11 and 16, the vessel made port calls in the Canadian cities of Quebec City, Charlottetown, and Halifax. The vessel departed Halifax at 2100 on October 16. The vessel's next port call was Portland, Maine.

On October 18, at 0448, the *Ocean Navigator* arrived at the pilot station in Portland. The vessel transited through Portland harbor en route to the Ocean Gate Passenger Terminal. While maneuvering, both of the vessel's main diesel engines, both electrical generators (auxiliary engines), both stern thrusters, and the bow thruster were operating. Engineering crewmembers stated that, throughout the transit to the terminal, all equipment was operating normally, other than one left bank cylinder exhaust high temperature alarm on the no. 1 (port) auxiliary engine, which was received at 0615.

About 0630, the *Ocean Navigator* docked starboard side to the pier, and about 0632, engineering crewmembers shut down the vessel's two main engines, both stern thrusters, and the bow thruster. About 0650, left and right bank cylinder exhaust high temperature alarms on the no. 1 (port) auxiliary engine were received in the engine control room (ECR). About 0708, the third engineer, who was on the 0400–0800 watch, shut down the no. 1 (port) auxiliary engine. The no. 2 (starboard) auxiliary engine continued to run, providing electrical power to the docked vessel. The engine was loaded up about 40% with a 400-kilowatt electrical load at 480 volts.

After the propulsion equipment was shut down, the third engineer and a motorman went into the stern thruster room to collect tools to conduct maintenance on the no. 1 auxiliary engine.[3] The two crewmembers had been assigned to troubleshoot the high exhaust temperature issue on the no. 1 auxiliary engine by inspecting the turbochargers and air coolers. When they returned to the engine room, the third engineer smelled oil and, subsequently, found a small lube oil leak on the inboard side of the running no. 2 auxiliary engine from a crankcase door cover. According to the third engineer, "the bolt was loose as we can see it turning." The third engineer and the motorman went to the ECR to get tools to tighten the bolt and then returned to the inboard side of the no. 2 auxiliary engine. According to the third engineer, as soon as they sat beside the engine, about 0710, "it exploded, and fire immediately spread across and above the generator." According to the ECR alarm

[3] A *motorman*, also known as a qualified member of the engineering department, stands watches with a credentialed engineer and performs a variety of tasks connected with the maintenance and repair of engine room equipment.

log, the fire detection system alarmed at 07:09:55, immediately followed by dozens of alarms, including "low lube oil pressure" and "oil filter plugged" alarms for the no. 2 auxiliary engine at 07:10:06. Six seconds later, at 07:10:12, the no. 2 auxiliary engine shut down due to low lube oil pressure. This resulted in a loss of electrical power throughout the vessel. The emergency generator automatically started, came online, and provided emergency lighting and power to vital equipment.

The engine room was equipped with flame detectors, smoke detectors, and pull stations to manually activate a fire alarm. The third engineer activated a manual pull station for the fire alarm as he and the motorman ran up to the ECR. Once inside the ECR, the third engineer noticed that the motorman's coveralls were on fire. The third engineer stated that he "tried to put out the fire on [the motorman's] coverall" before they ran up to deck 1 to the ship's hospital to receive first aid from the ship's doctor.

About the same time, the officer on watch on the bridge received a "chain of fire alarms in the engine room." The officer in the wheelhouse called the engineer on watch in the ECR via phone and also called the captain on his handheld radio. The captain, who was on the balcony of deck 3, felt "a shake of the ship" and saw thick smoke coming from the vessel's funnel. About this time, the chief engineer and chief mate arrived on scene in the ECR.

The captain reported to the wheelhouse, and the officer on watch advised him that a failure of the no. 2 auxiliary engine had resulted in an engine room fire. Additionally, he reported that the motorman, who was near the engine, had gotten burned and was receiving first aid from the ship's doctor.

About 0713, the captain used the public address system to notify the ship's crew of a fire aboard using a confidential phrase so as to not involve or alarm the passengers. From the emergency command center in the wheelhouse, the on-scene commander (the safety officer) established communication with the captain and the vessel's fire teams. He then began following the command center checklist from the vessel operator's safety management system, which provided guidance on emergency procedures for alerting, mustering, firefighting actions, and evacuation. The vessel's command center notified the fire team via handheld radio to assemble and check the engine room areas for fire. The chief engineer closed the quick-closing valves to the engines (stopping fuel supply to them), and the fire team shut down all ventilation fans, fire dampers, and watertight and fire screen doors, and prepared fire hoses.

About 0714, the captain called the US Coast Guard on VHF radio channel 16 and the vessel's agent, who was on the pier, via cell phone. The agent called shoreside emergency services (911). At 0716, the captain activated the general alarm throughout the vessel. The passengers and crew proceeded to their muster stations. The captain notified the operating company's designated person ashore who, in turn notified the company's qualified individual, their dedicated salvage and marine firefighting contractor, and the corporate crisis team.[4]

About 0718, crewmembers removed the injured motorman from the *Ocean Navigator*, and at 0721, after receiving permission from the captain, the first fire team entered the engine room—wearing self-contained breathing apparatus—to assess the fire.

About 0730, the local shoreside fire department arrived at the vessel. About this time, the captain received the report from the muster station team leaders that all passengers were accounted for at both muster stations. At 0731, the captain directed the passengers and non-essential crew to evacuate the *Ocean Navigator* to the pier via the gangway. One team from the local fire department and one of the ship's fire teams searched all cabins to ensure no passengers were left aboard the vessel. The other shoreside fire team joined the vessel's fire team in the engine room.

At 0741, the vessel's fire team that entered the engine room reported that there was no fire in the engine room; the team only observed black smoke. Crewmembers began ventilating the engine room by opening exterior doors. About this time, Coast Guard personnel and the company qualified individual arrived on scene.

By 0748, all passengers had been evacuated from the vessel and were mustered on the pier. Later that morning, once the vessel was safe to reenter, small groups of passengers, guided by crewmembers, were allowed back aboard to gather their luggage and belongings. They were then taken to hotel rooms, and the remainder of the cruise was cancelled. The motorman was admitted to a local hospital. He suffered burns on about 40% of his body.

1.3 Additional Information

1.3.1 Damage

After the casualty, National Transportation Safety Board and Coast Guard investigators boarded the vessel to examine the damage in the engine room. The

[4] (a) A *designated person ashore* is a person or persons ashore—with direct access to senior management—that implements and monitors the requirements of the safety management system. (b) A *qualified individual* is a person or persons ashore who has the knowledge and experience to oversee and monitor the safety of a vessel and its operations. They should also be able to communicate with the highest levels of the company and have the authority to report any deficiencies to management.

Coast Guard also requested assistance from a Bureau of Alcohol, Tobacco, Firearms and Explosives certified fire investigator, who participated in the examination of the damage. Investigators found that the no. 2 auxiliary engine was damaged beyond repair: the engine block, crankshaft, two connecting rods, counterweights, and other parts of the rotating assembly were damaged (see figure 5).

Figure 5. Damaged no. 2 auxiliary generator aboard *Ocean Navigator* after the engine failure. The circled area identifies the location of the engine block damage.

Investigators noted a hole about 10 inches high and 16 inches wide on the inboard side of the engine block in the area of the nos. 12 and 14 cylinders where the lower portion of the no. 13 connecting rod had been ejected (see figure 6). This area was located on the lower part of the engine near the deck plates between the two auxiliary engines.

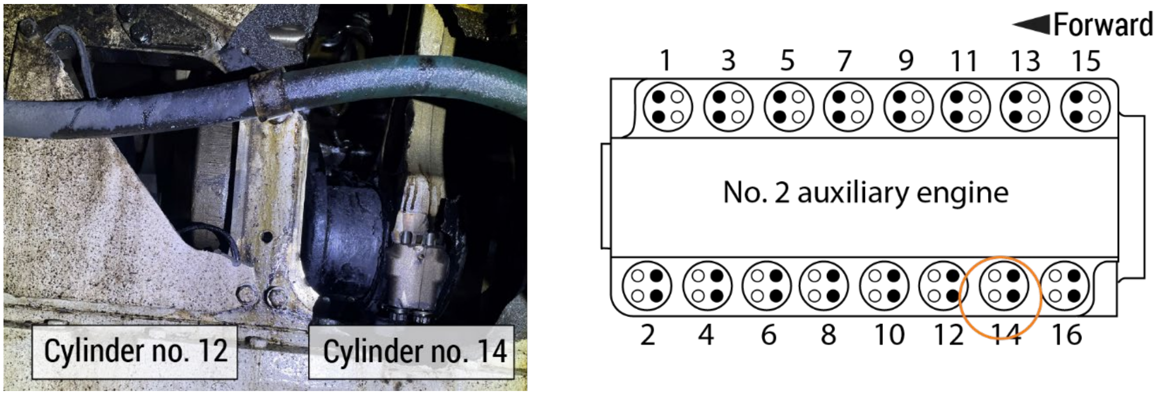

Figure 6. *Left to right*: Damaged engine block on no. 2 auxiliary engine aboard *Ocean Navigator* after the engine failure. Graphic identifying area of engine failure on the no. 2 auxiliary engine.

The most significant smoke and heat damage was directly across the decking from the area of the no. 14 cylinder where the engine block was ruptured and extended upward toward the overhead and inboard toward the no. 1 auxiliary engine. The area in the engine room around and above the no. 2 auxiliary engine sustained smoke and heat damage. Soot was observed on all surfaces in the engine room and was heaviest on the components near the deck plates between the two auxiliary engines.

The no. 1 auxiliary engine sustained fire damage to the turbocharger, piping, cables, and electrical insulation on the inboard side. The engine control module and its associated wiring harnesses were damaged and required replacement.

In the engine room above both auxiliary engines, several light fixtures were melted, and electrical cables were damaged. Most of the combustible items, such as insulation around pipes and ventilation ducts, experienced heat damage. The fire did not spread outside of the engine room.

1.3.2 Engine Maintenance

Engineering crewmembers tracked and recorded engine maintenance on spreadsheets and submitted the spreadsheets monthly to the operating company.

1.3.2.1 No. 2 Auxiliary Engine

In November 2019, third-party service technicians completed an in-frame overhaul on the no. 2 auxiliary engine. During the in-frame overhaul, the engine block was not removed; parts, such as pistons, cylinder liners, cylinder rings, main bearings, and connecting rod bearings, were inspected, rebuilt, or replaced. At the time of the overhaul, the engine had logged 21,151 running hours, and the hour meter was reset to zero hours.

In March 2023, third-party service technicians completed a top-end service overhaul on the no. 2 auxiliary engine, including the removal, inspection, and reworking of the cylinder head components. At the time of the overhaul, the no. 2 auxiliary engine had logged 10,050 running hours since the 2019 in-frame overhaul.

During the 2023 season, the no. 2 auxiliary engine averaged about 600 running hours per month. At the time of the engine failure, the no. 2 auxiliary engine had 14,329 running hours on it. The next main bearing inspection was to be conducted at 22,500 hours.

Aboard the *Ocean Navigator,* the engine monitoring system in the ECR had the ability to monitor cylinder exhaust temperatures but was not configured to monitor individual bearing temperatures of the engines. On the morning of the engine failure, there were no alarms from the no. 2 auxiliary engine in the ECR before the engine failure, and according to the vessel's chief engineer, the engine was running normally.

1.3.2.2 Lube Oil

Each of the Caterpillar 3516B engines aboard the *Ocean Navigator* had 16 cylinders, 9 main bearings, and 16 connecting rod bearings. The no. 2 auxiliary engine was equipped with a deep sump and had a capacity for 213 gallons of lube oil. The purpose of the lube oil system in diesel engines is to reduce friction, provide an oil film cushion that keeps metal-to-metal contact to a minimum, cool the engine parts, and cleanse the engine from particles and debris. Each of the connecting rod bearings for transverse cylinder pairs received lubricating oil from the main bearing through a drilled passage. In March 2022, the entire quantity of lube oil for the no. 2 auxiliary engine was replaced.

The vessel was equipped with a lube oil purifier, which used centrifugal force to separate impurities such as water and solid particles from the engine oil. The crew rotated its operation between each of the four diesel engines to purify the oil in each engine for 2–3 days. (The lube oil purifier was likely being used on main engine no. 2 on the day of the fire, although investigators could not definitely determine this.) Each engine was outfitted with pre-lube pumps, which were programmed to provide lube oil pressure to the engine before a start sequence. The engines were not equipped with oil mist detectors.

The lube oil that was used in the no. 2 auxiliary engine was 15W-40.[5] Between September and October 2023, before the engine failure, there were six entries in the engine logbook stating that lube oil had been added to the no. 2 auxiliary engine: a total of 140 liters (37 gallons) in September and 160 liters (42 gallons) in October.[6] On October 15, 20 liters (5 gallons) of lube oil were added to the no. 1 auxiliary engine. In the 2 months before the engine failure, no lube oil had been recorded being added to the two main engines.

The engine manufacturer's maintenance manual stated that the lube oil was required to be replaced every 1,000 hours of operation, unless analyzed using their proprietary oil analysis program.[7] According to the vessel's engineering maintenance log, engineering crewmembers took lube oil samples from all engines and sent the samples to a third-party testing facility to check for wear, contamination, and fluid condition. Before the engine failure, the last oil sample from the no. 2 auxiliary engine was taken on September 24, 2023, with about 13,900 hours on the engine. All results were within tolerances. Prior to this sample, an oil sample was analyzed on July 24, 2023, with about 12,600 running hours on the engine. The resulting analysis report indicated that all component wear rates were "normal" and that there was "no indication of any contamination of the oil." The report concluded that the fluid condition was "suitable for further service." The previous oil report from April 14, 2023 (with about 10,600 running hours) also indicated that all results were within tolerances. In September 2022, the oil sample status was described as "attention" due to elevated copper detected at 92 parts per million (ppm). The subsequent test result from a sample taken in April 2023 showed copper readings within tolerance at 18 ppm.

The engine manufacturer required lube oil filter elements to be replaced at each oil change, when the lube oil filter differential reached 15 psi, or when the lube oil filter elements had been used for 1,000 service hours. According to the vessel's

[5] (a) 15W-40 refers to the engine oil SAE class, which describes the viscosity of an oil. "15W" refers to the flowability at cold temperatures (W=winter). The engine oil is still pumpable down to -25°C (-13°F). The number "40" describes the flowability of the engine oil at an operating temperature of 100°C (212°F). (b) This engine oil met the engine manufacturer's specifications for Caterpillar 3516B diesel engines.

[6] The logbook entries were as follows: 9/20–40 liters, 9/23–40 liters, 9/28–60 liters. 10/1–40 liters, 10/15–80 liters, 10/17–40 liters.

[7] The proprietary analysis program, which used infrared analysis, analyzed used lube oil to determine if the oil change interval was suitable for the engine by testing for component wear rate, oil condition, oil contamination, and oil identification. Elevated results would alert operators of possible sources of wear from internal engine components such as cylinder liners, piston rings, bearings, and other sources of contamination.

engineering logs, the lube oil filter elements on the no. 2 auxiliary engine had been replaced on March 27, 2022, and May 25, 2023.

1.3.3 Postcasualty Engine Analysis

In the days after the engine failure, technicians downloaded data from the electronic control module from the no. 2 auxiliary engine. The logged event codes for low engine oil pressure warning, low engine oil pressure shutdown, and engine oil filter restriction warning were all in alarm condition. On October 20, a lube oil sample from the damaged no. 2 auxiliary engine was sent ashore for analysis. The resulting report identified that the aluminum level was abnormally high (17 ppm) and showed that the iron had increased from 23 ppm to 37 ppm since the last sample was tested in September. There were also increases in lead and tin.

In the months after the engine failure, the vessel remained docked in Portland, awaiting engine repairs. In February 2024, AQV was placed for sale. In April 2024, the *Ocean Navigator* and AQV's similar coastal passenger ship *Ocean Voyager* were auctioned and sold to Victory Cruise Lines. The new owner arranged to have the damaged no. 2 auxiliary engine replaced and the other damaged equipment repaired to bring the vessel back to service.

In September 2024, third-party service technicians disassembled all components from the no. 2 auxiliary engine aboard the *Ocean Navigator* in order to remove the damaged engine block from the vessel. During disassembly, technicians inspected all components as they were removed and found the engine block, crankshaft, several main bearings, connecting rod bearings, and the no. 14 fuel injector to be damaged. In November 2024, all the bearings from the engine and the no. 14 fuel injector were sent to a Caterpillar service facility, where factory-trained representatives agreed to conduct an inspection to document the condition of the components.

In January 2025, the technicians provided a dismantling report, which stated that all cylinder heads were removed from the engine, inspected, and found undamaged. All fuel injectors were removed from the cylinder heads; the plunger of the no. 14 fuel injector was found broken off from the body of the injector. All pistons and pins were removed; components from cylinder nos. 13 and 14 were "totally destroyed," and both cylinder liners were damaged (see figure 7). The technicians noted wear damage on the inside of the no. 14 cylinder liner.

All connecting rods were removed, and big end bearings were inspected (see figure 7). According to the technicians, "it is common for high RPM engine to have cavitation marks on the bearings, but these were really bad conditions, all of them." Several of the rod bearings showed signs of cavitation erosion, a degradation of a bearing resulting from vapor-filled cavities in the lubricating oil that may include loss of material, surface deformation, or changes in properties.[8]

Figure 7. *Left to right*: No. 13 piston and connecting rod from the no. 2 auxiliary engine, and no. 13 connecting rod bearings from the no. 2 auxiliary engine.

The technicians lifted the damaged engine block off its base to remove it from the vessel and access the crankshaft. The journal, which had the nos. 13 and 14 connecting rods attached to it, was severely damaged. Both counterweights had been forcibly disconnected from this section of the crankshaft (see figure 8).

[8] *Cavitation erosion* is caused by the formation and collapse of vapor bubbles in the oil film under conditions of rapid pressure changes during the crank cycle in internal combustion engines.

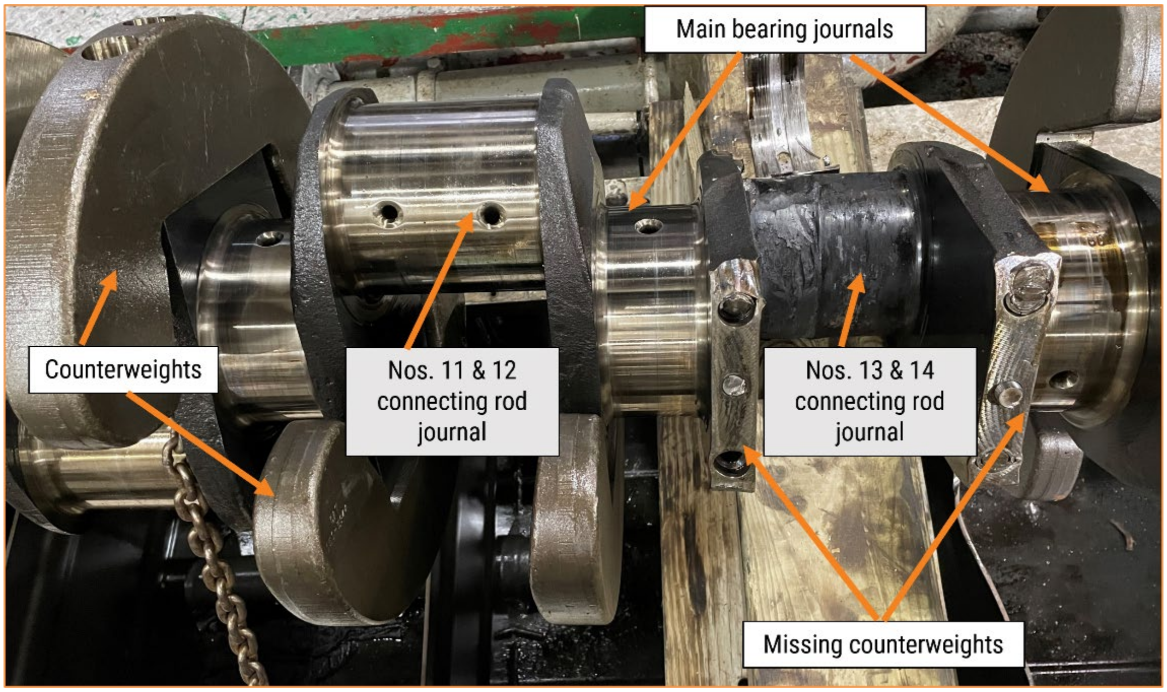

Figure 8. Removed crankshaft from damaged no. 2 auxiliary generator on board *Ocean Navigator* after the engine failure.

After the crankshaft was removed, all main bearings were inspected, and the no. 8 bearing, located directly aft of the affected cylinder, was determined to be in the worst condition. In January 2025, the engine block was replaced and the engine rebuilt by technicians. The operating company requested that the connecting rod bearings on the adjacent no. 1 auxiliary engine be inspected by the technicians. Based on the condition of the sampled bearing, all connecting rod bearings were replaced on the no. 1 auxiliary engine.

In February 2025, Caterpillar's rotating component engineers provided comments from the inspection of the no. 2 auxiliary engine components that had been sent from the *Ocean Navigator*. The engineers observed the front main bearing had "heavy local wear," main bearing nos. 5 and 7 had debris damage, and main bearing nos. 4 and 5 had "upper cavitation erosion that is not typical. This suggests oil quality or other lube [oil] issues." The rod bearings showed heavy cavitation, indicating "oil quality, oil level, oil-related issues should be investigated." The comments concluded that, "overall, evidence of debris damage, including large particle debris, and poor oil film are widespread."

2 Analysis

While the passenger vessel *Ocean Navigator* was docked in Portland, Maine, the vessel experienced a catastrophic engine failure of the no. 2 auxiliary diesel engine, which resulted in an engine room fire.

The crew quickly sealed the engine room by closing watertight doors, shutting off ventilation fans, closing dampers, and activating quick-closing fuel valves to effectively starve the fire of fuel and oxygen, which prevented the spread of the fire. Ultimately, the fire self-extinguished. Additionally, within a few minutes of the fire, the captain notified the crew of the emergency and sounded the general alarm for passengers and crewmembers to proceed to their muster stations. The *Ocean Navigator* crewmembers followed company procedures to muster all passengers and evacuate them from the vessel without injury. Therefore, the crew's response was timely and effective in extinguishing the engine room fire and ensuring the safe evacuation of passengers.

After the fire, third-party technicians disassembled all components from the no. 2 auxiliary engine and found the crankshaft, several main bearings, connecting rod bearings, and the no. 14 fuel injector to be damaged. Factory-trained representatives from the engine's manufacturer inspected the components and noted abnormal wear on the connecting rod bearings and main bearings, which showed signs of cavitation erosion (some considered excessive) and bearing damage from debris, indicating debris had been introduced at some point into the lube oil system. However, because pre- and postcasualty lube oil analysis indicated the lube oil was suitable for further service (with the exception of abnormally high levels of aluminum in the postcasualty analysis), it is unclear how debris initially entered the lube oil system of the engine.

Debris in the system would have caused scratching or scoring of the inner layer of the bearings (which typically had an aluminum-based alloy layer) as the debris circulated through the rotating components. As the debris wore away the bearing surfaces of the main bearings and connecting rod bearings, the clearances between the components would have begun to increase between the journals, crankshaft, and bearings. These increased clearances would have allowed more lube oil to flow out the sides of the bearings, reducing oil pressure, allowing excessive movement outside of these clearances, and resulting in a loss of oil film between the rotating components. Without an oil film, the friction of rotating components would have generated excessive heat, causing components, such as the no. 13 connecting rod and the crankshaft, to seize together and fail by welding themselves to the journal. As the engine continued to run at rated speed (1,800 rpm) and its crankshaft continued to rotate, the no. 13 connecting rod would have locked up and broken away from the crankshaft. Parts from the disconnected connecting rod collided chaotically as the crankshaft continued to turn, damaging other engine components until a portion of the no. 13 connecting rod or other internal components ruptured the engine block near the nos. 12 and 14 cylinders. Therefore, it is likely that debris entrained in the lube oil system of the no. 2 auxiliary engine led to the catastrophic damage to the engine. As a result of the block rupturing, hot, atomized lube oil vented through the damaged inspection covers and ignited off hot components internal to the engine.

The engineering logbooks for the vessel showed that, in the 2 months before the engine failure, crewmembers added lube oil to the no. 2 auxiliary engine (37 gallons in September and 42 gallons in October). In comparison, the crew added only about 5 gallons of lube oil to the no. 1 auxiliary engine, which operated at the same rpm and with similar load conditions. They also did not add oil to either of the main engines. The need to add significantly more lube oil to replenish the oil in the no. 2 auxiliary engine indicates that the engine was consuming lube oil at a greater rate than all the other engines. According to the engine manufacturer, when a diesel engine consumes more oil than normal, deposits (debris) can form on the pistons and in the combustion chamber, leading to packing of carbon under the piston rings and wear of the cylinder liner. The need to add significantly more lube oil to replenish the consumed oil in the no. 2 auxiliary engine indicated that there was likely an issue within the no. 2 auxiliary engine—either the engine was burning lube oil or the lube oil purifier was removing a larger quantity of contaminated oil during the purification process.

The crew had last changed the entire quantity of lube oil for the no. 2 auxiliary engine in September 2022—about 13 months before the engine failure—but the engine had operated more than 5,000 hours with this lube oil in the engine, exceeding the manufacturer’s recommendation by 5 times. The manufacturer’s recommendation serves to provide a timeline for when oil is required to be replaced to provide maximum performance of the lube oil and prevent wear to engine components. Because the crew did not follow the manufacturer-recommended intervals for the frequency of lube oil changes, contaminants, such as debris and chemical corrosives, entrained in the lube oil would have been likely to accumulate—diminishing the lubrication quality—and the effectiveness of additives in the lube oil would have been reduced—diminishing the performance of the lube oil.

Additionally, the crew had last changed the lube oil filter elements in May 2023, when the engine had about 11,000 hours on it. The engine manufacturer provided guidance for the lube oil filter elements to be replaced at every oil change or after the filter elements had been used for 1,000 hours. At the time of the engine failure, the engine had about 14,329 hours on it, indicating the filters had been used for 3,329 hours. This interval exceeded the manufacturer’s recommendation by over 3 times. The use of a filter beyond the manufacturer's recommended replacement guidance can result in a clogged filter. If a filter is clogged, the filter's bypass valve will remain open, preventing the lube oil from passing through the element, and any debris particles entrained in the oil will flow directly into the engine and remain circulating in the lube oil system. Therefore, because the filter elements had not been replaced in accordance with the manufacturer-recommended intervals, the filter elements were less effective than intended.

3 Conclusions

3.1 Probable Cause

The National Transportation Safety Board determines that the probable cause of the failure of the no. 2 auxiliary diesel generator engine and resulting engine room fire on board the passenger vessel *Ocean Navigator* was debris entrained in the engine's lube oil system—possibly due to the crew exceeding manufacturer-recommended intervals for changing the lube oil and oil filter elements—which caused catastrophic mechanical damage to the engine.

3.2 Lessons Learned

Containing Engine Room Fires

Engine rooms contain multiple fuel sources as well as mechanical ventilation, making the spaces especially vulnerable to rapidly spreading fires. After an engine room fire ignites, it is imperative to remove the sources of available fuel and ventilation to the fire to prevent it from spreading. In the engine room fire aboard the *Ocean Navigator*, the crew's quick action to secure engine room ventilation and engine fuel sources prevented the spread of fire and ultimately resulted in the fire self-extinguishing. Vessel crews should familiarize themselves and train frequently on machinery, fuel oil, lube oil, and ventilation shutoff systems to quickly act to contain and suppress engine room fires before they can spread to other spaces.

Adhering to Manufacturer's Recommended Maintenance Procedures and Intervals

Manufacturers provide maintenance recommendations and intervals (schedules) to ensure equipment operates safely, optimally, and reliably throughout its service life. By regularly reviewing equipment manufacturer manuals and guidance, operators can ensure conformance with recommended maintenance plans and mitigate the risk of equipment malfunction or failure.

Vessel Particulars

Vessel	***Ocean Navigator***
Type	Passenger (Passenger vessel)
Owner/Operator	Victory Cruise Lines (formerly American Queen Voyages) (Commercial)
Flag	Bahamas
Port of registry	Nassau
Year built	2004
Official number (US)	9000374
IMO number	9213131
Classification society	Bureau Veritas
Length (overall)	300.0 ft (91.4 m)
Breadth (max.)	50.0 ft (15.2 m)
Draft (casualty)	13.9 ft (4.2 m)
Tonnage	4,954 GT ITC
Engine power; manufacturer	2 × 2,000 hp (1,491 kW); Caterpillar 3516B diesel engines

NTSB investigators worked closely with our counterparts from **Coast Guard Sector Northern New England** throughout this investigation.

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